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Air Pollution and ASDs: A Deeper Dive into an Environmental Risk Factor

Lindsey Konkel

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Autism spectrum disorders (ASDs) affect an estimated 2.24% of children in the United States,[1] with a global prevalence estimated at approximately 0.7%.[2] Although the exact causes of ASDs are unknown, it is believed that both genetic and environmental factors play a role. Understanding the environmental factors is important, because they may provide a route for intervention, say the authors of a study in *Environmental Health Perspectives*.[3] In the new study, the researchers examined the potential effects of 155 hazardous air pollutants on ASD diagnosis and severity.

Of the potential environmental risk factors for ASDs identified in the past 12 years, air pollution may be the most studied.[4,5] "By and large, we see a higher risk for people living and breathing in areas with higher measured levels of air pollution," says Irva Hertz-Picciotto, director of the Program on Environmental Epidemiology of Autism and Neurodevelopment at the University of California, Davis, MIND Institute. Hertz-Picciotto was not involved in the current study.

Hazardous air pollutants include metals, volatile organic compounds, and particulate matter. It can be difficult to tease out which pollutants may be responsible for the reported associations between air pollution and ASDs. Evidence for links between ASDs and fine particulate matter is fairly consistent.[5,6,7] However, air pollution overall varies in its chemical composition across geographic regions and even seasons, and findings from studies examining individual constituent chemicals have not been consistent.[8,9]

"The motivation for this study was to identify which [hazardous air pollutants] are potential bad actors," says Amy Kalkbrenner, an epidemiologist at the University of Wisconsin–Milwaukee and lead study author.

Kalkbrenner and colleagues studied a group of 2,017 children from the Autism Genetic Resource Exchange (AGRE) cohort. The study group included both children with an ASD diagnosis and unaffected siblings. AGRE was formed in 1997 by Autism Speaks, an ASD advocacy organization. The study has yielded genetic data for more than 2,000 families of children with an ASD across the United States.[10]

The researchers included families with at least one child born between 1994 and 2007. They obtained data from the U.S. Environmental Protection Agency on air pollutant concentrations during the study period. From those data, they estimated average annual air pollutant concentrations at each family's home address at the time of their child's birth.

Air pollution is perhaps the most-studied risk factor for ASDs. However, emerging evidence increasingly points toward other risk factors, including mother's age, length of time between pregnancies, hospitalization with an infection while pregnant, and use of certain medications.[13] Image: © LumineImages/iStock.

The results showed that exposures to six hazardous air pollutants were associated with a significantly higher risk of being diagnosed with an ASD, whereas exposures to four others were associated with a lower risk of diagnosis. Among children with an ASD, two pollutants were associated with a significantly higher score for autism severity. Four were associated with lower ASD severity, including one of the pollutants that was associated with a lower risk of diagnosis.

Propionaldehyde and methyl *tert*-butyl ether (MTBE) had two of the strongest positive associations with ASD diagnosis. Each interquartile range increase in MTBE exposure was associated with a 2.33 times higher risk of being diagnosed with an ASD, and a comparable increase in propionaldehyde exposure was associated with a 1.92 times higher risk.

Propionaldehyde is a by-product of fossil fuel combustion. MTBE is a gasoline additive that was introduced as a replacement for tetraethyl lead. The additive was largely phased out in the United States in the mid-2000s[11] but is still widely used around the world.[12] The new findings, combined with prior studies, "point to a role for traffic-related air pollutants in the development of autism," says Kalkbrenner.

The study's focus on ASD severity is an important contribution, says Kristen Lyall, an environmental epidemiologist at the A.J. Drexel Autism Institute at Drexel University in Philadelphia. "Capturing severity of autism as well as broader autistic traits in both affected and unaffected individuals helps us learn more about whether these pollutants impact not just diagnosis but also subtler shifts in social functioning," says Lyall, who was not involved in the study.

The study design allowed the researchers to control for family-level factors that are difficult to measure directly but that could influence the development of ASDs. These include not only genetic factors but also socioeconomic variables or measures of poverty to which all members of a family may be equally exposed, explains Kalkbrenner.

Though Hertz-Picciotto says the study moves "one step closer to identifying bad actors," the researchers were not able to definitively screen out air pollutants that truly are not risk factors for ASDs. One reason for this is the inherent risk of error involved in measuring human exposure to air pollutants. Another key consideration is that people are not exposed to just one or two pollutants at a time in real life. "A key remaining question is whether some associations could be driven by a mixture of air [pollutants]," says Lyall. Future studies, she says, should investigate the influence of mixtures on ASD diagnosis and severity.

Lindsey Konkel is a New Jersey–based journalist who reports on science, health, and the environment.

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